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Protection of the atmosphere

Report of the Secretary-General

Addendum

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INTRODUCTION

1. Chapter 9 of Agenda 21 1/ (Protection of the atmosphere), contains four programme areas:

(a) Addressing the uncertainties: improving the scientific basis for decision-making;

(b) Promoting sustainable development:

(i) Energy development, efficiency and consumption;

(ii) Transportation;

(iii) Industrial development;

(iv) Terrestrial and marine resource development and land use;

(c) Preventing stratospheric ozone depletion;

(d) Transboundary atmospheric pollution.

2. The present report, which summarizes reports and publications of many United Nations, intergovernmental and non-governmental organizations, and which was reviewed at an inter-agency meeting, deals with each of these programme areas.

I. ADDRESSING THE UNCERTAINTIES: IMPROVING THE SCIENTIFIC BASIS FOR DECISION-MAKING*

3. The basic objectives of this programme area as formulated in Agenda 21 car be summarized as follows:

(a) To improve understanding of processes that influence and are influenced by the atmosphere;

(b) To build capacity and enhance international cooperation;

(c) To improve understanding of the economic and social consequences of atmospheric changes and of mitigation and response measures addressing such changes.

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* The sections on ozone layer depletion and transboundary air pollution (sects. III and IV below) also address issues of uncertainties and improving the scientific basis for decision-making.

A. General overview

4. The following achievements in addressing uncertainties and improving understanding of atmospheric processes should be noted:

(a) Research into biogeochemical cycles involving the Earth's atmosphere, the basic processes of the climate system and predictions of climate and atmospheric composition has resulted in improved understanding of the climate system. In addition, ozone projections and experimental seasonal forecasts, such as those involving teleconnections related to El Niño and Southern Oscillation (ENSO) events, are now available and have helped Governments to anticipate and alleviate adverse effects on their economies and populations;

(b) Observations of atmospheric and other related environmental parameters, using a variety of sophisticated techniques, provide basic data of fundamental importance. As a result, a number of high quality, global data sets are now available and are being used in the evaluation of strategies to detect changes and fluctuations in the atmosphere, to validate models of climate variability and to provide data on atmospheric composition. The application of data has enabled countries to make informed decisions in those sectors of their economies sensitive to climate and atmospheric variability and change;

(c) Study of the impacts of atmospheric changes, particularly ozone depletion and tropospheric pollution, has assisted Governments in the identification and implementation of suitable policy options and response measures;

(d) International scientific assessments sponsored by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in the areas of ozone depletion and global warming have played major roles in policy formulation by providing sound, policy-relevant scientific information.

5. Experience in the development of national and international programmes aimed at reducing uncertainties shows that success of these programmes depends critically on:

(a) An explicit demonstration of both the short- and long-term benefits to be gained as a result of the implementation of a programme;

(b) A clear and transparent description of the objectives and targets of a programme, as well as the criteria for assessing its success;

(c) Interaction and interdependency of national and international programmes;

(d) The interdisciplinary nature of a programme, in particular as regards involvement of physical, natural and social sciences;

(e) Effective national, regional and international coordinating mechanisms.

6. It appears, however, that in some instances it has not yet been possible to incorporate the above-mentioned items in national and international scientific and technical programmes addressing uncertainties related to the issue of protection of the atmosphere.

7. Furthermore, experience has proved that international scientific and technical assessments play a critical role in building consensus for international agreements (e.g., the Montreal Protocol and its subsequent amendments and adjustments; the role of the reports of the Intergovernmental Panel on Climate Change (IPCC) in the United Nations Framework Convention on Climate Change and the Berlin Mandate). 2/

B. Main policy issues

8. The main policy issues related to improving the scientific basis for decision-making are as follows:

(a) Development and coordination of international scientific programmes and observation systems, including those integrated under the Climate Agenda sponsored by the Food and Agriculture Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and its Intergovernmental Oceanographic Commission (IOC), the International Council of Scientific Unions (ICSU) and WMO;

(b) Further development of internationally coordinated systematic observations on a global basis;

(c) Continuation and enhancement of policy-relevant scientific assessments;

(d) Continuation of study and assessment of the linkages among the various environmental issues involving atmospheric pollution;

(e) Enhancement of research into processes in the Earth's atmosphere and the environmental, economic and social consequences;

(f) Overcoming the limited scientific capacity in developing countries, through education, training and institution-building;

(g) Ensuring access to information and assessing demands for information and basic data and coordination of research activities;

(h) Promotion of public awareness of the ways and means to protect the Earth's atmosphere;

(i) Provision of adequate human and financial resources, at both the national and international levels, for the implementation of scientific programmes concerning protection of the atmosphere.

C. Country experiences

9. During the past two decades, particularly following the establishment of the World Climate Programme in 1979, many countries enhanced their activities and improved coordination of those activities at the national level. More than 50 countries created National Climate Programmes (NCPs) to provide a focus for all climate-related activities within a country.

10. National coordination committees dealing with issues related to climate and atmospheric state were established in a number of countries. In some cases high-level ministerial committees for environment and climate matters were also established. Several countries have broadly based committees for "global change" studies.

11. With regard to research, a number of national research programmes were established and implemented, mainly in the developed countries, to address natural processes and impacts of atmospheric changes. Most developed and some developing countries are active in various major research projects, particularly within the WMO/ICSU/IOC World Climate Research Programme (WCRP) and the ICSU International Geosphere-Biosphere Programme (IGBP).

12. Assessments of the potential impact of variability and change of climate and the atmospheric environment were conducted by some countries through bilateral and multilateral support and as part of the UNEP-implemented World Climate Impact and Response Strategies Programme concerning areas both within and outside their national jurisdiction, including studies of vulnerability to sealevel rise, effects on agriculture, forests and other sensitive and important sectors, either as single or regional group efforts.

13. In addition the United Nations Framework Convention on Climate Change, the Convention on Biological Diversity, and the United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa require substantial scientific and technical inputs concerning climate and atmospheric environment. A shift to a multidisciplinary approach to climate and global change matters is clearly evident.

14. Unfortunately, many developing countries and those with economies in transition lack the infrastructures and expertise that would allow them to make or develop "good" use of activities related to the protection of the atmosphere at the national level and to play a full role in addressing international agreements. Access to the Global Environment Facility (GEF) and other bilateral support has redressed some of these deficiencies.

15. As far as the development of systematic observations of the atmosphere and climate, especially the development of a comprehensive Global Climate Observing System (GCOS) is concerned, virtually all countries participate in maintenance and enhancement of climate and atmosphere observation networks such as the WMO World Weather Watch and the Global Atmosphere Watch. This has become the cornerstone of international climatology and development of atmospheric sciences. There is, however, some concern that climate and atmospheric environment observing networks are being degraded in many countries as a result

of financial and other resource pressures, political changes, natural disasters and conflicts.

D. Experience of non-governmental organizations

16. Research activities of non-governmental organizations (NGOs) are coordinated at the international level by ICSU. With respect to support and coordination of climate and atmospheric research, ICSU is implementing two major programmes: the World Climate Research Programme (WCRP) jointly with WMO and IOC and the International Geosphere-Biosphere Programme (IGBP).

17. In 1990 another NGO, the International Social Science Council (ISSC), launched the Human Dimensions of Global Environmental Change Programme (HDP) with the objective of describing and understanding the role of humans in global change and the consequences of these changes on society. HDP will be increasingly supported by ICSU, thus providing a link for coordination with WCRP and IGBP.

18. The three programmes, WCRP, IGBP and HDP jointly sponsor the Global Change System for Analysis, Research and Training (START), which is the major initiative to promote research and enhance indigenous scientific capacity in developing countries.

19. Climate and atmospheric environment issues are being addressed by numerous NGOs particularly with respect to the global climate change issue; but also in connection with extreme natural climate events associated with ENSO and other periodically occurring phenomena.

E. Matters related to finance and capacity-building

20. The activities required are being undertaken by national and international organizations within programmes dealing mainly with climate and climate issues. Therefore, estimates provided in the recent inter-agency document entitled "The Climate Agenda: A Proposal for an Integrating Framework for International Climate-related Programmes" serve as a valuable indicator of financial requirements.

21. In the research area, although substantial funds are being provided to support current expenditure, IGBP core research and WCRP make up approximately half the estimated requirements. The current expenditure on the capacity-building START initiative is approximately one tenth of that required to fulfil its objectives. The resources available for applied climate science are already far from adequate and the increased involvement of the socio-economic research community in developing and understanding human influences on atmospheric processes is expected to call for substantial increase in funding over the next decade.

22. Atmospheric observation requirements could likely be met, according to the Climate Agenda, with additional investments of 10 per cent to 20 per cent above current expenditures, in order to provide additional stations, increase data

quality, and provide for upgrades in the instrumentation. Expanded ocean observation will require larger investments since current operational systems are very limited. Such investments would enable increased coverage, deployment of additional observing systems and improved data collection and distribution systems. Land observation requirements are being met partially by existing networks of ecosystem and hydrology measurements but require enhanced coordination and integration. Costs are estimated to be an additional 10 per cent to 20 per cent of current expenditure.

23. Substantial national expenditures are required to establish and operate national climate impact programmes. While developed countries have established programmes and, in some cases, are assisting developing countries to undertake climate impact studies, there is a need for additional work, particularly in countries where such issues are barely addressed. It is estimated that more than 100 countries require significant enhancement of national studies.

24. Governments need to allocate resources and other commitments in response to the above estimates of requirements, in accordance with their own national capabilities and expertise. There are a number of other ways by which resources could be provided. They include GEF, voluntary contributions of Governments to special trust funds and/or directly to the countries concerned and augmentation and adjustment of budgets of international organizations.

25. A limited number of industrialized countries can both meet their domestic needs for scientific and technical information and be active partners in international efforts. The majority of the developing countries, many smaller industrialized countries and countries with economies in transition, need to be involved. In such countries, capacity-building activities must incorporate provision of assistance for technology and methodology transfer; access to data and products to meet varying user capabilities; and training through fellowships, scholarships and support to developing region training centres.

26. The many scientific capacity-building initiatives undertaken recently include the development of regional networks to support research, data and information exchange services. The Global Change System for Analysis, Research and Training (START) and the development of centres of excellence, such as the African Centre of Meteorological Applications for Development (ACMAD), are notable examples.

F. Recent developments in international cooperation and future plans

Intergovernmental processes

27. Effective implementation of the United Nations Framework Convention on Climate Change is intimately linked to understanding the climate system and how socio-economic development is affecting it. The Convention contains an explicit commitment by Governments to cooperate in scientific, technical and socio-economic research, systematic observations and development of data archives related to the climate system and to reduce or eliminate the remaining

uncertainties regarding the causes, effects, magnitude and timing of climate change.

28. In this connection, the Subsidiary Body for Scientific and Technological Advice (SBSTA) of the Conference of the Parties to the Convention stated recently that it would cooperate with competent international bodies and programmes in areas related to methodological, technical, socio-economic and technological questions. It is important that the development of this cooperation be accelerated to enable the Conference of the Parties to make full use of the multidisciplinary expertise available in international, governmental and non-governmental organizations and programmes.

29. IPCC continues to provide the Conference of the Parties with up-to-date, policy-oriented information; and particularly since it has been identified by SBSTA as one of the independent and prominent sources of scientific and technical information relevant to the implementation of the Convention. The Second Assessment Report of IPCC, adopted in 1995, should be regarded as a primary source of information which Governments may need concerning the above matters.

II. PROMOTING SUSTAINABLE DEVELOPMENT

30. This programme area comprises four subprogrammes. It is somewhat different from the programme areas that follow it, which relate directly to the condition of the atmosphere. Each subprogramme area considers a socio-economic sector in which economic activities need to be sensitive to the promotion of sustainable development, since they have considerable and serious impacts on the atmosphere.

31. When issues of sustainability are considered, the availability of resources and consumption patterns also need to be considered.

A. Energy development, efficiency and consumption

32. The objective of this subprogramme area is to reduce adverse effects on the atmosphere from the energy sector in a manner that reflects the need for equity and availability of adequate supplies for the variety of situations in different countries.

1. General overview

33. As the major source of global energy at present, fossil fuels have adverse effects on air quality and the atmosphere at large. Consequently, increases in energy consumption, especially of fossil fuels, have given rise to environmental concerns, at the national, regional and global levels. This report discusses this important policy issue in sustainable development only in so far as it impacts on the atmosphere.

34. According to the Secretary-General's report on changing global energy patterns (E/C.13/1994/2) by the year 2020, the developed market economies as a

whole are projected to increase their consumption of fossil fuels by 1.04 per cent per annum to reach 4.7 billion toe (tons of oil equivalent). This represents per capita consumption of 4,523 koe (kilograms of oil equivalent). By contrast, the consumption of developing countries is projected to increase by 4.21 per cent per annum (slightly more than four times the rate of growth in the developed countries) to reach 6.6 billion toe (or just 40 per cent more than the consumption in developed countries). Per capita consumption will reach no more than 1,000 koe (or less than a quarter of that in developed countries). For the economies in transition, fossil fuels consumption is expected to increase by 1.23 per cent per annum to reach 2.5 billion toe by the year 2020, with per capita consumption remaining the highest at 5,208 koe.

35. As a result, emissions of carbon as CO_2 to the atmosphere from the combustion of fossil fuels are projected to double globally between 1990 and 2020. Similarly large emissions of nitrogen and sulphur compounds, as well as particulates might be expected. However, the trend in developed countries has been to decouple emissions of sulphur and nitrogen oxides from those of CO_2.

36. In the commercial energy sector, trends in energy demand structure show that the shares of natural gas and hydropower will increase while those of oil and coal will decline. Natural gas is projected to be the faster growing source of energy, accounting for over 25 per cent of total energy demand by the turn of the century. Natural gas use has expanded greatly in electricity generation, which in turn is projected to quadruple in developing countries within the next decade. Coal will remain the main source of energy in many countries (countries members of the Organisation for Economic Cooperation and Development (OECD), Central and Eastern European countries, China, India, the Russian Federation). The use of coal in generating electricity is expected to double in developing countries, by the year 2005. Hydropower is also projected to increase, mainly in developing countries in spite of serious financial constraints, environmental considerations and the untapped resources becoming increasingly concentrated in remote areas.

37. Current projections or scenarios of future trends in the development and use of new and renewable sources of energy differ widely. The rapid reductions in cost that the more optimistic projections predict are uncertain, since they assume, either explicitly or implicitly, large increases in government subsidies and R&D programmes, while the trend world wide is towards free market economies and less government involvement in business activities. The United Nations Solar Energy Group on Environment and Development (A/AC.218/1992/5/Rev.1, annex I) estimates that by the year 2020, new and renewable sources of energy would supply about one third of world energy consumption, or even one half in the more optimistic scenario. The more conservative estimate of the World Energy Council (WEC) projects a gradual increase from 18 per cent to 21 per cent by the year 2020, or 30 per cent in an ecologically driven scenario.

38. In the non-commercial energy sector, biomass is an important source of energy, particularly in developing countries, where it accounted for 20 per cent of total energy consumption. Most consumption is in rural areas. It ranges from about 10 per cent in China, to about 34 per cent in India and over 75 per cent in a few African countries south of the Sahara. Currently, annual consumption of biomass in all forms in developing countries is estimated at

1,000 million tons of oil equivalent (42,631 petajoules), about as much as their annual total oil consumption. About 45 per cent of this biomass is wood, used either directly or as charcoal, which is not always produced in a sustainable manner. The rest is agricultural residues and animal waste. Biomass is also used to produce ethanol as fuel for vehicles. Some European countries obtain 10 per cent to 15 per cent of their primary energy consumption from biomass.

39. These trends have conflicting impacts on the atmosphere. While increased use of natural gas is less damaging environmentally, increased coal burning could be detrimental, locally, regionally and globally. Fuelwood, which is the most important source in many countries, is only a renewable resource if it is consumed at sustainable rates. Its combustion would thus lead to no net increase in CO_2, since this was already absorbed from the atmosphere by photosynthesis. However, in many parts of the world, fuelwood is consumed faster than it can be replaced and its consumption is unsustainable and increases CO_2 emissions by both releasing the sequestrated carbon and reducing carbon sinks. More often than not, burning biomass for use in rural areas is inefficient, unhealthy and highly polluting, particularly indoors.

40. The report of the Secretary-General on energy and the protection of the atmosphere, prepared for consideration by the Committee on New and Renewable Sources of Energy and on Energy for Development at its second session, discusses issues related to the protection of the atmosphere from energy-related sources, as well as strategies for mitigating and avoiding adverse impacts of possible climate change. The report assesses available policy measures for the protection of the atmosphere within the context of sustainable development. It also reviews the disparities in the capacity to mitigate and adapt to environmental changes from energy production and use among different countries and regions. The Intergovernmental Panel on Climate Change in its Second Assessment Report presented, inter alia, a detailed analysis of the scientific understanding of climate change from energy-related activities and policy measures for the abatement and mitigation of environmental impacts.

41. Most of the countries of the OECD region are characterized by mature and highly developed economies with high levels of income, energy consumption and energy-related greenhouse gas (GHG) emissions. As a region they share the highest responsibility for the historical and current energy use and GHG emissions. Consequently, they also have the highest near- to medium-term emissions reduction potential, the highest financial and technological mitigation and adaptation capabilities and generally also the lowest vulnerability to environmental impacts, both as a result of their high income levels and high capabilities for adaptation.

42. The economies in transition, between 1990 and 1994, registered about a 40 per cent drop in their combined economic output. As a consequence, primary energy demand declined by some 25 per cent and energy-related CO_2 emissions by about 30 per cent. Recent projections indicate that it may take two to three decades before energy use and thus energy emission levels return to their pre-restructuring levels. This means that these countries are probably well below any current or near-term commitments for stabilization of emissions formulated within the United Nations Framework Convention on Climate Change.

43. The historical and current contribution to energy-related global environmental impacts by developing countries is low, but is expected to increase with accelerated economic and social development to meet the demands of their expanding population. Most projections of CO_2 emissions from developing countries indicate that it will be about 50 years before the developing countries have a similar share in atmospheric concentration increases as industrialized countries have today, but the difference is that they will have more than 80 per cent of the global population by then. Developing countries with their greater reliance on agriculture, will be more vulnerable to possible climate changes, as several studies show that damage from climate change accounts for a significantly higher proportion of economic activities in developing countries than in industrialized countries. Currently, agriculture accounts for about 21 per cent of total economic output in developing countries compared with only 4 per cent in industrial countries. Moreover, adaptation capabilities of developing countries will be more limited considering their low national incomes, with consequent low spending on research and development and institutional capacities to deal with climate change.

2. Main policy issues

44. Energy demand growth globally has been rapid since the collapse of oil prices in 1986. In spite of the marked reductions in demand in the Commonwealth of Independent States (CIS) and Central and Eastern European countries, oil demand in 1994 was higher than in 1985 by more than 8 million barrels per day.

45. The challenge developed countries face today is meeting their commitments as Parties to the United Nations Framework Convention on Climate Change. The first session of the Conference of the Parties held in Berlin (March/April 1995) initiated, under the Berlin Mandate, open-ended negotiations leading to the adoption of a protocol or other legal instrument at the third session, in 1997. It should be noted that this does not relate only to the energy sector, but extends to activities relating to curtailing GHG emissions and developing sinks in such other sectors as industry, transport, agriculture, forestry, and urbanization. These issues and others related to climate change are dealt with in more detail in a special report.

46. National technology development programmes indicate a shift, both in Government and in industry, in the funding of technology development towards short-term issues. This is considered best suited to existing infrastructures. However, this incremental approach needs to be accompanied by orientation of at least some government and industry effort towards long-term technology breakthroughs (e.g., hydrogen, biofuels and other renewable energy sources), to mitigate GHG emissions from increased fossil energy use and avert a possible global energy supply crisis over the long term.

47. To be effective, international technology development initiatives must be relevant to all countries if they are to have an impact on atmospheric concentrations of pollutants. While most technologies developed will be applicable to both developed and developing countries, other forms of these technologies will be necessary to meet the special conditions and needs of developing and least developed countries. The development and deployment of

more efficient, new and renewable energy sources, including appropriate biomass energy technologies, provide but one example of a situation in which endogenous human resources in science and technology need to be actively involved.

3. Country experience*

48. Developed countries have achieved notable decreases in energy intensity owing to improvements in generation and end-use efficiency in many socio-economic sectors. Some reductions in emissions of SO_2 and NO_x have resulted from improved efficiency and fuel substitutions. This was overshadowed by increased demand. Switching to nuclear energy for electricity generation, a zero emission technology, is an option for some countries provided that generally acceptable responses can be found to concerns such as reactor-safety, radioactive waste transport and disposal and nuclear weapons proliferation. Considerable improvements achieved in methods of energy exploration and drilling operations on land and offshore have resulted in considerable expansion in exploitation of the resource base, productivity and quality. Some countries still depend on coal as the main fuel for electricity generation, while research continues on "clean" coal burning. Reactions to commitments in the United Nations Framework Convention on Climate Change have varied:

(a) Some countries have adopted national targets, backed by funded plans of action;

(b) Some countries have adopted unilateral, but preliminary and/or conditional commitments to targets;

(c) Other countries have adjusted their targets to the need for economic growth;

(d) Some countries have set targets based on per capita emissions;

(e) Very few countries are committed to a set of policies that will stabilize emissions at the 1990 target level;

(f) A regional economic integration organization has set regional targets balanced out by allowing economic-growth-adjusted projections of some countries to be offset by reductions in others.

49. Experiences in developing countries have varied considerably because of the differences in resource base, energy demand, economic situation, technological capacity, population and development strategy, even within the same region. Excluding northern and southern Africa, the rest of the continent relies on fuelwood as a main source of energy for household, services and small enterprises. Per capita consumption of commercial energy in Africa is about 12 gigajoules (or a fifth of the global average). Energy intensity is among the

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* Experiences relating to the transport and industry sectors are dealt with in subsections B and C below.

highest in the world and losses in electricity transmission are substantial. Equatorial Africa has immense hydro potential, still untapped, which could provide hydroelectricity to a considerable area in sub-Saharan Africa and even the northern area of the continent. Other renewable sources of energy that could be further developed include ethanol from conversion of sugar (and blended with gasoline for gasohol) and other modern biomass fuels. The development of oil from coal is carried out in South Africa but is becoming less economically viable given the present crude oil price situation.

50. South Asia still has a comparatively low level of per capita consumption, even though the region has witnessed substantial increases in energy consumption. This has been coupled with slower rates of increase in biomass resources, even though the region has considerable potential to develop this and other forms of new and renewable sources of energy. Another feature is a lower level of efficiency in many appliances.

51. In South and Central America, oil and gas represent a large proportion of total energy demand. Argentina and Venezuela are among the most gas-intensive countries world wide. Hydroelectricity generation accounts for the major share of the electricity supply in the region. In Brazil, as in many developing countries, biomass plays an important role in primary energy demand. Energy consumption throughout the region is rising, while energy intensity is more or less constant.

52. Throughout the developing world energy subsidies are being reduced consistently, and energy intensity, if not total energy demand, is expected to decrease as a result. There has also been a recent trend in some developing countries, particularly in eastern and southern Asia to develop or consider the introduction of nuclear power. China, India, Pakistan and the Republic of Korea have active programmes, whereas such countries as Indonesia, Malaysia, the Philippines and Thailand are receiving assistance from the International Atomic Energy Agency (IAEA) in planning and developing the requisite human resources and infrastructure to ensure safe and efficient operation and maintenance of future facilities.

53. The countries with economies in transition have generally had high energy intensities due to the predominance of energy-intensive industries and high intensities in the residential/commercial sector. They have experienced falling demand over the past few years; but demand is expected to recover as adjustment to a market economy proceeds and economic growth revives. As for the energy mix, the demand for gas - an important source - has not fallen so rapidly as that of other fuels and is expected to grow slowly in the future. In Central and Eastern Europe solid fuels accounted for over half the primary fuel mix. In countries of the former Soviet Union, coal plays a prominent role; recently, however, the demand for coal has been declining appreciably in these regions. There are serious concerns about the safety of power reactors of Soviet design in the countries of these regions. Interim measures have been taken in some plants to compensate for design deficiencies in such areas as fire protection, residual heat and its removal and emergency electricity supply. Since nuclear power makes a significant contribution to the energy mix, it is costly and difficult to substitute, and closure programmes have slowed down.

4. Experiences of major groups and non-governmental organizations

54. Non-governmental organizations (NGOs) in the developed countries have been very vocal for many years in denouncing air pollution and mobilizing public pressure to introduce measures, sometimes costly, to reduce the impacts of the energy sector on air quality. This has been particularly pronounced of late in the debate over climate change and the extensive adaptation measures needed to meet this new challenge. Some consumer groups have actively promoted the use of energy efficient appliances.

55. Industrial and business associations in developed countries are becoming involved in research to address energy development, efficiency and consumption (e.g., the Electric Power Research Institute, the Business Council for a Sustainable Energy Future, the International Petroleum Industry Environmental Conservation Association (IPIECA)).

56. NGOs in developing countries have played an important role in promoting the use of alternative energy sources, and improved supply and end-use efficiency, particularly in rural areas.

5. Technology transfer, finance and capacity-building

57. Technology development and transfer issues cover a wide range of options and opportunities, ranging from improvements in the sources and production techniques of energy, to energy end-use efficiency in all sectors (industry, transport, residential, agriculture) including the shift to less energy-intensive materials. The newly formulated strategy of the GEF places particular emphasis on developing alternative energy sources that can meet future demand without facing scarcity of energy resources, causing serious impacts on the atmosphere at large or resulting in adverse climate change. This covers options such as solar, wind and biofuels, which have yet to be developed intensively and extensively.

58. According to some scenarios, sustainable biomass energy has the potential to become the largest single source of energy globally, providing from 17 per cent to 35 per cent of the total demand for primary energy in 2050 if sustainability policies are adopted and technological advances achieved in the production of liquid, solid and gaseous fuels from biomass, based on the use of fast-growing species, soil-water species relationships, new harvesting and conversion techniques or the application of genetically engineered bacteria. However, such programmes call for substantial investments sustained over relatively long time horizons and improved cooperation between developed and developing countries.

59. The technological developments required need to extend beyond the development and deployment of new sources, and necessitate generation and distribution technologies to address end-use energy intensity through the development of alternative materials and their production technologies, in all sectors, that are less energy intensive and less polluting over their entire life cycles.

60. Many developed countries as well as United Nations and other intergovernmental organizations are supporting capacity-building activities in developing countries and in countries with economies in transition to improve capacity in energy planning and demand management and to improve pricing policies and generation, distribution and end-use efficiencies.

6. International cooperation and future plans

61. A large number of programmes have been developed by the United Nations system related to technical cooperation with developing countries, including information sharing, advisory services, training workshops and seminars, publications, and database management. Activities on the promotion of the development and more widespread use of new and renewable energy resources have been on the increase. Practically all activities involve, in one way or another, energy conservation and efficient use, as well as issues relating to energy and the environment. Planned programmes also reflect this trend. The report of the Secretary-General on energy activities of the United Nations system (E/C.13/1996/7) is to be considered by the Committee on New and Renewable Sources of Energy and on Energy for Development at its second session (New York, 12-23 February 1996).

62. While the regional commissions stress regional conditions and needs, the different departments of the United Nations Secretariat monitor and analyse global energy trends and their impacts on environment and development, compile and publish energy statistics and information and provide services and assistance for large-scale projects.

63. The regional project, "Asia least-cost greenhouse gas abatement strategy", funded by the Asian Development Bank with the Economic and Social Commission for Asia and the Pacific (ESCAP) executing part of the programme, is designed to assist the 12 participating countries in improving estimates of the emissions and sinks of the principal GHGs and in undertaking economic, technological and environmental analyses of options for reducing future emissions and enhancing sinks. ESCAP is also providing assistance in the project on energy and air pollution in north-east Asia; the objective of the project, involving six countries, is to enhance human and organizational capacities for the protection of the atmosphere by improving the efficiency and operational management of coal-fired power plants and environmental monitoring.

64. Almost every specialized agency addresses, through similar types of programmes and activities, issues specifically relating to their sector specialization. They also cooperate through a number of standing collaborative mechanisms in multidisciplinary programmes, particularly those relating to the impacts of energy development on environment and development, efficiency and consumption. The World Bank has been funding many large-scale energy projects emphasizing of late their environmental implications. The Bank has also emphasized the value of eliminating energy subsidies as a prerequisite for sustainability in the energy sector. UNESCO has initiated the World Solar Energy Programme, which will be launched at the World Solar Summit (Harare, Zimbabwe, September 1996).

65. Several intergovernmental organizations in both developed and developing countries have extensive energy programmes at the global and regional levels - for example, the Organization of the Petroleum Exporting Countries (OPEC), the International Energy Agency (IEA) of OECD and the Latin American Energy Organization (OLADE). The regional development banks have been funding many energy development projects, either alone or in cooperation with one another and the World Bank.

66. In future, apart from expanding the resource base and developing major technological breakthroughs, the main challenge facing the world will be the necessity of examining lifestyles in all regions with the objective of matching supply and demand for energy in a stable and sustainable manner and implementing programmes to promote sustainability. Immediate targets are information sharing, better networking, coordinated research and joint demonstration and deployment projects.

67. To assist decision makers in devising policies for sustainable electricity production, an inter-agency project entitled "Decades" provides a comprehensive database for comparing different energy sources and also sophisticated software for power sector planning. Decades is a joint effort of the European Union, ESCAP, the World Bank, IAEA, the International Institute for Applied Systems Analysis (IIASA), OECD/IEA, OPEC, UNEP, UNIDO and WMO.

B. Transportation

68. The objective of the programme area on transportation is to develop and promote feasible activities to limit or control the harmful impacts of transportation systems on the environment at large and emissions into the atmosphere in particular taking into account development priorities, specific local conditions and safety aspects.

1. General overview

69. The environmental impacts of transport systems extend beyond the emission of pollutants and noise to include the appropriation of large areas of land, the resource consumption and waste generation associated with the construction of roads, rail tracks, runways, wharves, stations and terminals needed for transport systems.

70. Needless to say, the most pervasive impacts are those of emissions that are directly related to the types and quantities of fuels used in vehicles for land, sea or air transport. Energy use in the transportation sector has been increasing steadily over the past quarter of a century at rates that are at least 50 per cent higher than those for the industrial sector and 80 per cent more than those for other end-use sectors. At present, the transport sector consumes about half the world's petroleum and is projected to consume 60 per cent by the year 2010.

71. The environmental impacts of the transportation sector are particularly acute in urban areas. Urbanization is increasing rapidly world wide, leading to

greater urban sprawl, particularly in developing countries. The prospect of a doubling of current mobility levels in developing countries represents a huge challenge for the urban environment and transport policy. In city centres, congestion has reduced average speeds drastically on major roads, resulting in economic losses and substantial increases in emissions, in both developed and developing countries.

72. The transportation of goods has been shifting in the recent past from railways to roads in both developed and developing countries, although for different reasons, bringing with it high rates of increases in road networks. This has raised serious problems in land-use planning and adds to the marked increases in pollution, noise and road accidents. The trend now is towards increasing the share of mass transit and railways in passenger traffic, as well as relying increasingly on railways in freight haulage, particularly over long distances.

73. Air transport continues to grow world wide, unaffected to any serious extent by the recent recession, slow economic growth or the losses incurred by airlines. Problems of congested airspace and delayed traffic have also increased. This has been accompanied by increasing concern for the environment, and notable improvements in specific fuel consumption, primarily driven by economic considerations, resulting in lower emissions of CO_2 (currently estimated at 3 per cent of the global total) and particulates than would otherwise have occurred. However, NO_x emissions that lead to the formation of tropospheric ozone, a greenhouse gas, at flying altitudes, are still a problem that is currently being tackled in phases. While the transport of passengers by sea over long distances has virtually ceased and the transport of oil has decreased, there is steady growth in seaborne dry cargo that is expected to continue. The trend of building large vessels has now been reversed and the average size of tankers and cargo vessels has been reduced significantly. Some countries are witnessing a revival of transport by inland waterways. Canal systems that were neglected for decades are now being rehabilitated.

74. Work has been proceeding on several fronts to address the pollution problems of transportation systems, particularly motor vehicles. Improved efficiency of fuel burning is an obvious priority. A wide range of available and potential technologies for decreasing energy intensity is currently being pursued. However, technical potential is not necessarily identical to economic (cost effective) or market potentials. While vehicle efficiencies have been improving steadily, this seems to have encouraged increased vehicle use and a shift in some countries towards bigger and more powerful cars. In developing countries improved maintenance could result in substantial improvements in energy efficiency as well as significant decreases in hydrocarbon and NO_x emissions.

75. The use of unleaded gasoline is currently spreading from many developed countries to some developing countries and leading to reductions in lead emissions, one of the more serious hazards associated with the use of gasoline. In a number of developed countries, reformulated or oxygenated gasoline that reduces emissions of carbon monoxide are slowly being introduced and their use is becoming mandatory. Use of alternative fuels has been increasing, although the use of alcohol (ethanol) that was widespread in Brazil is currently

receding, while the use of natural gas, prominent in some countries, particularly Italy, is also spreading to some developing countries.

76. Electric vehicles are being developed and promoted particularly in some developed countries. They face considerable technical, operational and waste disposal problems that are still without satisfactory solutions.

2. Country experiences

77. Developed countries are actively pursuing initiatives to analyse in depth the barriers to the adoption of policies and measures leading to environmentally sustainable transportation systems, including technological change, travel-demand management, restructured land-use patterns, new institutional arrangements, as well as the strategies for implementing those measures, taking into account the interdependence among indicators and the conflicts that can arise (e.g., increased NO_x emissions associated with reduced CO_2 emissions).

78. Work is also proceeding on specific issues such as environmental monitoring of roads, eco-balances, life cycle analyses, economic evaluation of the environmental impacts of the transport sector, particularly social costs, market failures and effects of the development of trade.

79. In developing countries, the adverse environmental and socio-economic impacts of current national transportation systems are becoming more and more serious and glaring, even over the short term. They currently face the challenge of reconciling their development priority objectives under difficult economic conditions with the relatively large-scale social, economic, technical and management tasks involved in relaxing or solving their serious transportation problems. Consequently, overall progress in the development of virtually all transport sectors has been sluggish. However, public transport has been given priority. A growing number of cities in developing countries are attempting to reduce congestion and pollution by building urban underground systems or smaller and less expensive light rail systems. Alternative fuels, particularly natural gas, are being introduced gradually.

80. In the countries with economies in transition, the changes in their economic systems have resulted in the gradual phase-out of subsidized transport systems. Together with the general slowdown in economic activity, there may have been a stabilization of, or even a slight reduction in, emissions from their transport systems in some cases. However, it is possible that as the economic slowdown ends and eventually reverses, emissions could begin to rise again.

3. Policy issues

81. An overall assessment of different technologies has to take account of the different composition of emissions they produce and the trade-offs involved in fuel substitutions. Apart from CO_2, there are other emissions that contribute to global warming, such as NO_x and CO. NO_x, together with uncombusted hydrocarbons, contributes to the formation of ozone, while CO and NO_x affect the

balance of methane. While diesel engines are more efficient and emit less CO_2, they produce more NO_x and particulates than does gasoline.

82. Economic instruments also need to be analysed in depth, since their impacts differ appreciably in different regions. To be effective, the tax rate should be set equal to the marginal social value of reducing pollution to provide an incentive to individuals to buy more fuel efficient vehicles, reduce usage or improve maintenance, and utilize public transport more as systems improve.

83. The rapid growth in transport fuel consumption world wide has implications for energy, security, local and global environments and the balance of payments. From 1992 to 2010, global transport oil demand is expected to increase by 16 million barrels a day. This is eight times the expected increase in demand for heavy oil products used mainly for power generation. The shift to lighter oil products calls for increased investment in refineries and needs to be taken into account.

84. However, it can generally be said that most societies are still a long way from articulating feasible plans that would leave a marked impact on the current situation.

4. Experiences of major groups and non-governmental organizations

85. Environmental NGOs in developed countries have been quite active in raising public awareness of the environmental impacts, particularly in urban areas. This has covered both land and air transport. Public pressure has resulted in a curtailment of transport activities in certain areas and a rethinking about plans for extending road networks and airports. In some cases NGOs resorted to positive action. One notable example of the involvement of NGOs is in air transport, where associations of manufacturers, operators and pilots have been participating with national and international governmental organizations in studying environmental issues and in formulating feasible strategies for their solution.

86. In some of the larger developing countries, environmental NGOs have also been active in raising public awareness and advocating life style changes that result in alternative modes of transport. Municipal authorities both independently or as a result of programmes initiated by the International Council for Local Environmental Initiatives (ICLEI) or local government groups have been proactive in initiating local energy and transport policies.

5. Finance, technology transfer and capacity-building

87. Practically all transport technologies are developed in the industrialized countries. The main obstacle to their transfer to developing countries is lack of resources to adopt desirable changes in transport equipment, fuels used and the necessary installations for their production and distribution.

88. Little is done in developing countries to develop alternative technologies better suited to their conditions, particularly in rural and remote areas. There is a general need for capacity-building in developing countries, particularly in the planning and management of appropriate transport systems. Some donor countries and regional organizations in the industrialized countries are supporting the development of national/regional capacity to address such problems in developing country regions.

6. International cooperation and future plans

89. In economically linked regions (e.g., those covered by the European Union, OECD) cooperation in tackling policy and management issues is growing, since these impact not only environment and transboundary pollution, but also trade and the economy. The OECD and its IEA have been actively involved for several years now in addressing many environmental and techno-economic issues relating to the transport sector in the OECD countries.

90. UNEP, the International Civil Aviation Organization (ICAO) and IMO are the organizations of the United Nations system specifically entrusted with the responsibility of addressing transportation issues. IMO concentrates on marine transport where the environmental issues are those of marine pollution. UNEP addresses all aspects of the transport-environment matrix and cooperates closely with OECD and other related United Nations agencies and professional and business organizations. In air transport, ICAO has a Committee on Aviation Environmental Protection (CAEP) that is actively compiling data and investigating solutions to problems of emissions.

91. Considerable challenges face the world in the future, such as:

(a) The need to curtail the overall use of fossil fuels in transportation;

(b) The need to take special measures in urban areas with respect to redesigning transport systems, restoring desirable balances between the different modes (public versus private; road, rail, air and waterways) and instituting appropriate management systems to control demand.

Addressing these and similar challenges needs public support, considerable community participation and much closer international cooperation.

C. Industrial development

92. The basic objective of this programme area is the promotion of industrial development without causing adverse impacts on the atmosphere.

1. General overview

93. Industrial impacts on the atmosphere occur in more than one way. First, as a major end user of energy, the industrial sector is responsible for more than one third of CO_2 emissions world wide. At present, industrial sector energy use

has ranged from about 30 per cent in developed countries, 35 per cent to 45 per cent in developing countries, 40 per cent in countries with economies in transition to 60 per cent in China. The impacts may also be more severe than these figures indicate, especially where coal is the primary energy resource.

94. Apart from efforts to improve the efficiency of energy production and transmission, fuel substitution and exploiting alternative energy sources, several approaches are currently being explored to reduce harmful industrial emissions:

(a) Recycling increasing proportions of materials and chemicals;

(b) Dematerialization of production, or using fewer materials to produce the same product;

(c) Lengthening the useful life of products so as to serve the same purpose, using fewer materials;

(d) Using fewer energy-intensive materials in the products;

(e) Using more renewable raw materials;

(f) Designing products to be more energy efficient; that is, using less energy for the same service over a product's useful life.

2. Country experiences

95. In developed countries, the trend towards "dematerialization" of products has improved energy efficiency, while the "decarbonization" of fuels should slow down the rates of industrial emissions. For many industrialized countries, there has been little increase in industrial emissions over the past two decades. Major opportunities have been identified for further decreases that will require changes in national policies and, in some cases, international cooperation.

96. Technological changes in energy-intensive industries and the tendency to shift those industries to developing countries have contributed to reductions in emissions. For example, the iron and steel industry, which mostly consumes coal, is expanding the use of electric furnaces to process scrap steel at greater energy efficiencies and reduced emissions. Furthermore, as more iron and steel is produced in developing regions, production in developed countries is expected to stabilize or even decrease slightly.

97. While transnational corporations are now spending more money on developing new technologies that combine environmental and economic benefits, smaller enterprises still need substantial technical and financial support to adopt cleaner production techniques.

98. Generally, in developing countries, end-use efficiency can be improved considerably using available technologies. For example, steel and cement

production in China and India requires up to twice as much energy per tonne as in the United States of America or Japan.

99. In some newly industrializing countries, rapid development of the industrial sector took place, without much consideration of the environmental impact. Now these countries are faced with the necessity of spending considerable financial resources on remedial actions and/or introducing cleaner production technologies and techniques.

100. Industrial production in countries with economies in transition has witnessed a decline recently, coupled with more open disclosures on the detrimental impact of past industrial activity. End-use efficiency in industry and efforts to shift to cleaner production are currently supported by other developed countries, United Nations and other intergovernmental organizations and bodies and development banks.

3. Policy issues

101. The present mix of regulation and incentives has not had a marked effect on fostering the adoption of existing less polluting technologies, nor has it encouraged investment in the development of new technologies. There is need for a sustained research effort aimed at developing socially acceptable mixes of regulation, incentives and technical support to encourage industry to develop and deploy cleaner production technologies.

102. In some developed countries, public pressure is already forcing promotion of the production of environmentally friendly goods. Industrial associations and the business community at large are beginning to take steps to minimize environmental damage by adopting voluntary guidelines and codes of conduct, at home, as well as in technology transfer to developing countries. These moves need to be strengthened and supported at the national and international levels and through the implementation of innovative mechanisms.

103. Technology choices, mainly in developing countries, are less constrained by the existence of suitable technologies than by the availability of funding and the institutional means for obtaining and incorporating these technologies into their economies.

4. Experiences of major groups and non-governmental organizations

104. Environmental NGOs, particularly in developed countries, have played an important role in increasing public awareness about the environmental impacts of using particular products. They have also drawn attention to the environmental implications of all the production steps, including exploration, extraction, exploitation of raw materials, recycling and emissions throughout the product life cycle. The emphasis has now moved to promoting sustainable consumption patterns - a much more socially complex task.

105. Industrial associations are adopting voluntary environmental agendas, codes, practices and the concept of sustainable development (e.g., technology transfer guidelines, the Responsible Care movement, formation of the World Business Council for Sustainable Development).

106. Professional bodies (engineers, scientists, managers) have been more active in embracing the notion of sustainable production and investigating techniques to achieve this aim, particularly in the industrial sector.

5. Financing technology and capacity-building

107. Technological options to reduce the impact of industry on the atmosphere while continuing to meet current demand are being sought by many national, regional and international organizations. This calls for a comprehensive re-examination of industrial activity addressing the full range of environmental and economic issues to meet development goals within the local and global sustainability capacities.

108. More emphasis needs to be devoted to technology transfer to industrializing countries and the establishment of innovative technological capacity-building in developing countries.

109. Possibly the most significant contribution will come through accelerated investment in technologies that reduce both energy consumption, the use of other industrial raw materials with low energy content, as well as more energy-efficient products. High rates of investment add new capital rapidly to the existing stock or replace old stock, thus increasing the ratio of industrial output using energy efficient technologies. Thus industrial development in developing countries may accelerate with smaller energy requirements than developed countries had experienced at similar stages of industrialization.

6. International cooperation and future plans

110. Two organizations of the United Nations system are heavily involved in promoting environmentally friendly industry: UNEP and the United Nations Industrial Development Organization (UNIDO). Through its Industry and Environment Centre, UNEP has been in the forefront at the national, regional and international levels, interacting with Governments, business enterprises and associations as well as NGOs. UNIDO initiated its Environmentally Sound Industrial Development (ESID) programme at an international conference in preparation for UNCED. Six years ago UNEP launched its cleaner production programme, which spread very quickly in many countries. Together, the two organizations have been publishing manuals and guidelines on prevention of industrial pollution and cleaner production. They also operate multi-faceted information services, organize training workshops and seminars and have recently cooperated in setting up national cleaner production centres in a number of developing countries. They provide advisory services and technical assistance programmes/projects. They have maintained close relations with such other United Nations organizations, as the World Health Organization (WHO), the

International Labour Organization (ILO), FAO and UNESCO, in articulating the environmental and health hazards involved in industrial production.

111. The United Nations Framework Convention on Climate Change, while not including operational programmes in the areas of energy, transportation and industrial development, is an international legal instrument whose implementation is relevant to future developments in these sectors.

112. Regional intergovernmental organizations, particularly OECD and the European Union have maintained large-scale programmes addressing the issue of the interrelationships between industrial activity and sustainable development. Their programmes also address the problem in the context of developing countries and countries with economies in transition, and provide advisory and technical assistance.

113. As mentioned earlier, business associations (World Business Council for Sustainable Development, International Chamber of Commerce (ICC)) and professional bodies are now cooperating closely with United Nations and regional intergovernmental organizations in addressing the issues involved in sustainable industrial development.

D. Terrestrial and marine resources development and land use

114. This programme has two main objectives. First, to promote terrestrial and marine resource utilization and land-use practices that reduce atmospheric air pollution and/or limit anthropogenic emissions of GHGs and conserve and enhance all sinks of GHGs, as well as natural and environmental resources. Secondly, to ensure that atmospheric changes and their socio-economic and ecological impacts are fully taken into account in policies and programmes concerning resource utilization and land-use practices.

1. General overview

115. Approximately two thirds of the world's population live in coastal regions and two thirds of the world's cities with populations of 2.5 million or more are near estuaries. Within the next two or three decades the population of coastal zones is expected to almost double. This leads to continuing environmental degradation (e.g., air and water pollution, loss of natural habitats, overexploitation of commercial stocks of fish).

116. These conditions are likely to be exacerbated by climate change and sealevel rise, while ozone layer depletion could cause reductions in biomass production and biodiversity in the world's oceans.

117. The International Conference to Adopt a Global Plan of Action for the Protection of the Marine Environment from Land-based Activities, held in Washington D.C., from 23 October to 3 November 1995, adopted the Washington Declaration and a Global Programme of Action. The implementation of the Programme of Action will take into account the influence of climate and related sealevel change and their marine environment impacts.

118. The degradation of drylands (desertification) is an increasingly severe problem in many parts of the world. The impacts of human-induced dryland changes on the earth-atmosphere energy balance are now better understood, as far as how temperature responds to these changes. On a global scale, climate change is expected to cause wide variations in crop yields and productivity across regions and among localities, even though existing studies show that, on the whole, global agricultural production could be maintained at doubled equivalent CO_2 equilibrium conditions.

119. Forests are one of the two main global sinks of CO_2 and atmospheric CO_2 levels can be reduced through preserving existing forests, planting trees to create sinks to sequester CO_2 and substituting fossil fuels directly by forest-derived biomass fuels. World-wide forest systems, which cover about 4.1 billion hectare (ha) contain about 359 and 787 petagrams (Pg=10^{15} grams) of carbon in their vegetation and soils, respectively. Deforestation in 1990 resulted in emissions of about 1.6 Pg of carbon while forest expansion, especially in the mid-latitudes, sequestered about 0.9 Pg.

120. Conservation of existing forests through sustainable forest management appears to be the most viable option to ensure that forests can continue to act as a reservoir of carbon, while reducing the rate of deforestation and resulting in less CO_2 being emitted to the atmosphere. Other benefits include commercial products, preservation of biological diversity, recreational value and so forth.

121. While forests are a major sink for GHGs, they are also affected by climate change. A sustained increase of 1°C in g'obal mean temperature is enough to cause changes in regional climates that will affect the growth and regenerative capacity of forests in many parts of the world. Under doubled equivalent CO_2 equilibrium conditions, a global average of one third (varying by region from one seventh to two thirds) of the existing global forested area is likely to undergo a change in broad vegetation types, with the most changes occurring in high latitudes and fewer in the tropics. Boreal forests are likely to undergo irregular and substantial losses in living trees. The exact timing and extent of this pattern is still uncertain. Climate and land-use impacts on the temperate forests are expected to be relatively less drastic.

122. The effect of climate change on biological diversity is also of great concern. Conserving biological diversity is important because ecosystems function as a planetary life-support system, renewing atmospheric oxygen and playing a central role in the biogeochemical cycle.

2. Policy issues

123. At its third session, the Commission on Sustainable Development decided to establish an Intergovernmental Panel on Forests, 3/ to provide a process for dealing with, inter alia, transboundary pollution and its effect on forest degradation as well as the role of forests in mitigating the effects of desertification and land degradation and the use of national forest and land use strategies.

124. Mitigation actions depend on reducing barriers to the dissemination and transfer of technology, mobilization of financial resources, supporting capacity-building in developing countries and other approaches to assist in the implementation of behavioural changes and technological opportunities in all regions of the world.

125. The missing links in the current approach for dealing with these problems relate to policies of countries to dispel the notion of donor-recipient aid and instil the notion of collaborative endeavour to address what is after all a global menace.

3. Country experiences

126. The developed countries have been more active in monitoring the condition of their terrestrial ecosystems, and developing the scientific basis and data sets on the dynamics of these systems. However, the issues of inadequate management and treatment of waste water and other land-based sources of marine pollution, particularly persistent organic pollutants (POPs), are yet to be dealt with effectively. Suboptimal management of fish stocks has also resulted in political tensions among some countries. The probable impacts of climate change on ecosystems are receiving more attention, even though concerted action programmes of adaptation are yet to be formulated. The condition of boreal forests seems to have stabilized and no further significant losses are expected.

127. Developing countries, as a whole, have been only partially successful in preserving their ecosystems, which are the richest in biodiversity and whose forests are the main terrestrial GHG sinks. Indications are that the rate of deforestation in Brazil is declining, while countries of South-East Asia are beginning to introduce appropriate forest management systems. Desertification remains a serious problem in many countries, particularly in Africa. Often, the need to deal with immediate social problems has resulted in lower priority being allocated to environmental concerns likely to consume scarce financial resources needed elsewhere.

128. In Central Asia, desertification and the destruction of habitats are emerging as serious problems, as the full scale of degradation is becoming clearer. Various programmes have been targeted for controlling degradation and for rehabilitation (e.g., in the Aral Sea) with help from various intergovernmental sources.

129. In Siberia, work has started on protecting the taiga in the boreal forest region, which is the largest terrestrial biome on earth and a factor in the stabilization of climate change.

4. Finance, technology transfer and capacity-building

130. Expert consultations on many of the issues involved in dealing with terrestrial and marine ecosystems are being organized in many regions, dealing with the scientific-technical, socio-economic and behavioural aspects within the framework of each region. Guidelines, publications and data sets are also being

produced by various governmental and non-governmental organizations and associations. Various donor countries and intergovernmental organizations are providing funding for national and regional programmes for the rehabilitation of ecosystems in different regions. As noted earlier, this falls short of the resources needed to implement existing action plans.

5. International cooperation and plans for the future

131. The United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa was finalized in 1994 and an interim secretariat set up at Geneva. The Convention has regional implementation annexes for Africa, Asia, Latin America and the Caribbean and the Northern Mediterranean. The Convention is currently open for signature and ratification and has not yet come into force.

132. The parties to the Convention on Biological Diversity have held two conferences. Some countries have developed, with help from United Nations and other intergovernmental organizations, their own studies and action plans. UNEP has recently produced a comprehensive report on biodiversity world wide, which provides the latest scientific survey of biological diversity world wide and the most up-to-date estimates of rates of losses. According to the report, the present situation is alarming.

133. The United Nations University (UNU) has initiated a collaborative research programme on "People, land management and environmental changes" (PLEC) to study sustainable agrotechnology and maintenance of biological biodiversity in the tropics and subtropics. It is obvious that preserving terrestrial and marine ecosystems is an issue that is closely related to population, lifestyle and consumption pattern issues. In future, apart from the climate change implications, these new elements will have to be integrated in any further work on the preservation of global ecosystems.

134. The UNESCO international and intergovernmental environmental programmes promote research and studies on the interaction between the use and conservation of marine and terrestrial resources and global change. The Man and the Biosphere (MAB) programme, the programmes of IOC, the International Hydrological Programme (IHP), the International Geological Correlation Programme (IGCP) and the natural hazards programme provide information on such interactions.

III. PREVENTING STRATOSPHERIC OZONE DEPLETION

135. Agenda 21 sets two main objectives for this programme:

(a) Realization of the objectives of the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on substances that deplete the ozone layer and its London Amendment, particularly in developing countries;

(b) Developing strategies to mitigate the adverse effects of increased incidence of ultraviolet radiation due to stratospheric ozone layer depletion and modification.

A. General overview

136. Notable success has already been achieved in the implementation of the agreements. The atmospheric growth rates of several major ozone depleting substances (ODS) have reversed or slowed. The phase-out for the developed countries is scheduled to be completed by January 1996.

137. The financial mechanism (the Multilateral Fund) established in 1991 has funded a portfolio of projects to help article 5 (developing) countries in phasing out ODS. When fully implemented these projects are expected to phase out an annual total of 51,500 ozone depleting potential (ODP) tonnes, corresponding to 35 per cent of ODP-weighted ODS consumption reported by article 5 countries for 1992 and 25 per cent of the estimated unconstrained ODS consumption in these countries in 1993. The implementing agencies (UNDP, UNIDO, World Bank) in cooperation with the Executive Committee and the Fund secretariat, have steadily increased the rate of project development and implementation, from some $9 million in the first year, to $150 million in 1994. In 79 article 5 countries, 781 projects have been approved. The ratio of investment projects resulting directly in ODS phase-out has steadily increased and is now more than 90 per cent of total allocations. The total approved allocations for projects so far represent 15 per cent to 20 per cent of the total estimated cost of meeting the current targets of ODS phase-out in article 5 countries by 2010.

138. Parties to the Montreal Protocol, at the meeting held in Vienna from 28 November to 7 December 1995, adopted a new phase-out schedule for methyl bromide and agreed on somewhat tighter controls for hydrochlorofluorocarbons (HCFCs). Under the new agreement, developed countries, which account for some 80 per cent of global methyl bromide use, will phase-out the chemical by the year 2010. Developing countries agreed to freeze methyl bromide by 2002 at average 1995-1998 levels.

139. Commendable effort has been exerted to raise public awareness of the problem, to compile useful, up-to-date information systematically and disseminate it widely - to the public, the technical/professional community and decision makers. Capacity-building, through workshops, fellowships, technical publications and advisory services has provided valuable support to technology transfer and project implementation.

140. On the scientific front, the major findings and observations are:

(a) The conclusion that anthropogenic chlorine and bromine compounds are the cause of polar ozone depletion has been further strengthened, as well as the link between stratospheric ozone decrease and the increase in surface ultraviolet radiation;

(b) Growth rates of several major ODS have reversed or slowed. Nevertheless, low global ozone levels were observed in 1992 and 1993. The northern hemisphere decreases were larger than those in the southern hemisphere;

(c) Downward trends in total columnar ozone continue to be greater than the estimates derived from numerical models;

(d) Peak global ozone losses are expected to occur during the next several years;

(e) Approaches to lowering stratospheric chlorine and bromine abundances are limited;

(f) Many of the substitutes for the CFCs and halons are also notable GHGs.

B. Main policy issues

141. Main policy issues involve:

(a) Matching the global phase-out schedule of all significant ODS to the most recent scientific findings and assessments of risk to the ozone layer;

(b) Ensuring the adequacy of financial resources to cover the incremental costs of phase-out in article 5 countries;

(c) Proper regulation of transitional substances (e.g., HCFCs);

(d) Effective management of existing stocks of already produced ODS; minimizing premature obsolescence of existing ODS-using equipment;

(e) Formulating and implementing policies to encourage innovation and productivity growth while satisfying the imperative of protecting the ozone layer;

(f) Adjustments and amendments of the Montreal Protocol and phase-out schedules in the light of new scientific evidence;

(g) Halting illegal trade in CFCs;

(h) Control of methyl bromide.

C. Country experiences

142. Among the developed countries, members of the European Union completed their internal CFC phase-out on 1 January 1995. Most other developed countries were scheduled for a 1 January 1996 phase-out. The phase-out is virtually complete in most developed countries with the production of non-CFC automotive air conditioners, refrigerators and foams, with some exceptions for electronics and aerospace products and non-medical aerosol products. Illegal trade in CFCs

is a growing problem. Commitment to the Multilateral Fund appears to be declining.

143. Developing countries are generally making progress in ODS phase-out within the 10-year grace period and in a variety of application areas. The largest number of projects under the Multilateral Fund has been in the foam sector. However, the refrigeration sector ranks first in terms of funds disbursed. It should be noted that despite these efforts, consumption of ODS in some developing countries has increased. The 10-year delay for compliance and the Multilateral Fund have been critical to obtaining the cooperation of all parties.

144. The small island developing States are low volume consumers of ODS. Some are parties to the Montreal Protocol. UNEP has been called upon to lead an approach to support phase-out in these countries.

145. For the countries with economies in transition, the Central European countries should not face serious difficulties in ODS phase-out, even though they require some external assistance. In the CIS and Baltic countries non-compliance will inevitably occur. The only available source of funding for this group of countries is the Global Environment Facility. Compliance of the CIS and Baltic countries was not achieved by 1 January 1996. It will probably take three to five more years for these countries to comply.

146. Fraudulent smuggling of newly produced CFCs and halons, disguised as recycled products, is appreciable.

147. The consumption of ODS continues to increase in many developing countries. National execution of projects to phase-out ODS (in World Bank projects) has so far faced considerable delays.

D. Experiences of major groups and non-governmental organizations

148. The achievements in implementing the agreements would not have been possible without the constant exchange of ideas between Governments, scientists, industry, NGOs, the media and the general public. Since the beginning of the negotiations, the industrial and manufacturers associations, their individual members and the principal environmental NGOs world wide were involved. As an example of the continuation of this approach, during the twelfth open-ended working group meeting, apart from representatives of 89 countries, seven United Nations agencies, members of the panels, the Fund secretariat, the secretariats of GEF, the United Nations Framework Convention on Climate Change and WTO, 15 NGOs and 32 industrial enterprises participated.

E. Finance, technology transfer and capacity-building

149. The Multilateral Fund has established itself, started operations, and expanded its scope of activities in a remarkably short time. Fulfilment of funding commitments to the Multilateral Fund is at a higher level than for any

other United Nations programme. The implementing agencies have respected in their work the principle proposed by the Technology and Economics Assessment Panel (TEAP) that the basic choice of phase-out technology is the prerogative of the enterprise in question as long as it is an approved phase-out technology. However, until very recently the actual flow of technology to the shop floor level has been moderate, primarily as a result of the slow pace of project implementation. Some enterprises in article 5 countries indicate that the licence fees for technology transfer are high and that production licences for alternative substances are difficult to obtain. However, an independent study team found no evidence of substantive impediments to the flow of technologies supported by the Multilateral Fund.

150. There is no experience so far of the Fund supporting the development of endogenous ODS phaseout technologies, in spite of a decision of the Executive Committee that endogenous research in substitutes and equipment for recycling and destruction could be supported by the Fund.

F. International cooperation and future plans

151. The Montreal Protocol and its London and Copenhagen amendments and adjustments are the first examples of world-wide cooperation between all countries, developed and developing, to tackle an environmental problem of a global dimension. This pioneering example set the pace and provided workable formulations of strategies and plans, as well as mechanisms of implementation and the provision of global funding, that have guided endeavours to tackle other global environmental problems such as protection of international waters, biodiversity and climate change.

152. While UNEP has played the leading role in bringing this pioneering initiative to fruition, three main United Nations organizations (World Bank, UNDP and UNIDO) have cooperated effectively with the Executive Committee and the secretariat in successfully implementing the programme. The cooperation of UNEP and WMO has been successful in the preparation of a series of scientific assessments, providing scientific advice to the parties to the Vienna Convention.

153. The challenge now facing the international community is to ensure that the momentum generated in the past few years is maintained until ODS are completely phased out on the basis of the most recent scientific and technical findings, stratospheric ozone restored to pre-industrial levels and harmful UV radiation curtailed.

IV. TRANSBOUNDARY ATMOSPHERIC POLLUTION

154. The overall objective of this programme is to strengthen/develop capabilities world wide to monitor the sources and extent of transboundary air pollution in a sustained manner, to analyse the behaviour of pollutants and their fate and to mitigate their impact, whether they are the result of ongoing activities, natural disasters or accidents.

A. General overview

155. Although the first international inquiry into transboundary air pollution was carried out in North America in the 1930s, the first international effort to monitor and control transboundary atmospheric pollution was the 1979 Convention on Long-range Transboundary Air Pollution and its protocols, establishing a regional regime in Europe and North America for this purpose, involving at present 40 parties under the auspices of the United Nations Economic Commission for Europe, which is responsible for the legal and institutional framework for the control of transboundary air pollution. By the time the United Nations Conference on Environment and Development (UNCED) was held in 1992, four other protocols had been adopted by varying numbers of countries covering sulphur emissions, nitrogen oxides (NO_x) and volatile organic compounds (VOCs). Recent developments are as follows:

(a) A protocol on Further Reduction of Sulphur Emissions has been adopted; it has been signed by 28 parties and ratified by 3;

(b) The highest priority has been given to developing "effects-based" strategies that apply the multi-pollutant, multi-effect critical load approach. This is expected to provide further reduction of the emissions of nitrogen compounds and, if appropriate, VOCs that contribute to photochemical pollution, acidification and eutrophication, and their effects on human health, the environment and materials;

(c) Work is now being carried out to address the presence of heavy metals and persistent organic pollutants with the aim of negotiating a protocol on the control of these materials.

B. Policy issues

156. No similar multinational, regional programmes have been initiated on a scale comparable to that of Europe and North America. This is a major gap that needs to be filled, particularly in certain regions of Latin America, Africa and South-East Asia, where the problems of transboundary atmospheric pollution are increasing. This is a major challenge that needs to be addressed over the long term in a carefully structured and prioritized action programme (i.e., the impact of acidification associated with expected industrialization on sensitive soils).

C. Country experiences

157. A 1994 major review confirmed that the implementation of the Convention on Long-range Transboundary Air Pollution has had a marked impact on reducing sulphur emissions and stabilizing NO_x in the ECE region:

(a) The Sulphur Protocol reduced emissions by 48 per cent between 1980 and 1993. For the whole of Europe, including non-parties to the Protocol, emissions are below 30,000 kt, a 45 per cent reduction compared with 1980. All parties

have achieved the reduction target and some parties have reduced their sulphur emissions by 80 per cent or more;

(b) Emissions of NO_x for all parties were reduced by 4 per cent between 1987 and 1993. Eighteen of the 25 parties to the 1988 Protocol have reached the stabilization target (1987) and some have achieved further reductions up to more than 25 per cent.

158. On a global scale, 25 countries are currently reporting air pollution concentrations data to GEMS/AIR, a joint UNEP/WHO global urban air quality monitoring and assessment programme. Reporting of air pollution concentration data has largely improved since the beginning of 1995.

159. Countries that have revitalized their participation include Kenya and the Philippines. New participants include Bolivia, Costa Rica, El Salvador, Guatemala, Honduras, Jordan, Mexico, Mozambique, Nepal, Nigeria, Paraguay, Peru, Romania, South Africa, the United Republic of Tanzania and Uruguay.

D. Experiences of major groups and non-governmental organizations

160. The participation of these organizations, both environment- and industry-oriented, was through national delegations. NGOs have contributed to raising awareness of the ecological effects of atmospheric pollution, as well as to the status of the implementation of agreed measures and to the countries international obligations.

E. Finance, technology and capacity-building

161. Some parties may want to consider joint implementation, in order to meet their obligations in the most cost-effective manner. It is recognized, however, that the bulk of the resources required must be furnished by the countries where the sources of pollution are located. Furthermore, providing external assistance on an interim basis can play an important catalytic role in accelerating implementation and can also facilitate more cost-effective regional reduction patterns.

162. The Oslo Ministerial Declaration calls upon all parties to the Convention, as well as international financial institutions, to support the implementation process through bilateral and multilateral assistance to parties with economies in transition.

163. Continuous effort is called for in consolidating and extending the international scientific, economic and technological basis for further reductions of transboundary air pollution, including facilitating technology exchange and the exchange of knowledge and information and providing for adequate capacity-building (by organizing seminars, workshops and/or training courses on specific topics).

F. Recent developments in international cooperation and future plans

164. Experience shows that additional measures are needed to further reduce emissions of sulphur and nitrogen compounds and to control other major air pollutants. An "effects-based" approach, the critical load concept, best available technology, energy savings, the application of economic instruments and other considerations have been accepted as a basis for future protocols and have led to a differentiation of emission reduction obligations of the parties. The new Sulphur Protocol, which aims at gradually attaining critical loads, sets long-term targets for reductions in sulphur emissions. It has been recognized that critical loads will not be reached in one single step.

165. Parties to the Protocol on Volatile Organic Compounds (VOCs), not yet in force, are also expected, as a second step, to negotiate further measures to reduce VOC emissions or their transboundary fluxes and their resulting secondary photochemical oxidant products, taking into account, inter alia, the best available scientific and technological developments, scientifically determined critical levels and internationally accepted target levels, as well as the role of nitrogen oxides in the formation of photochemical oxidants.

166. Considerable effort is devoted to increasing further the efficiency of all activities under the Convention and to enhancing cooperation and coordination between relevant international organizations and conventions, to ensure adequate exchange of information and avoid duplication of work.

167. Urban areas are now recognized as one of the main sources of transboundary atmospheric pollution. GEMS/AIR provides an effective means of clarifying the dynamics of transboundary atmosphere pollution; it also provides guidance in respect of global priority-setting, policy formulation and appropriate action. The scope of the programme has now been broadened beyond addressing health issues to covering the whole range of information needed for rational air quality management. The programme now looks into emission sources, dispersion patterns and management strategies.

168. Recent developments in GEMS/AIR include:

(a) The extension of regional training courses;

(b) The launching of twinning projects, developed with the help of the Environmental Protection Agency of the United States of America, through which developing countries are provided with used monitoring devices, not currently used in developed countries but still operational;

(c) Collaborative reviews of the capabilities of a city in air pollution monitoring to identify needs, as well as support for network participants in obtaining quality data for their use and determining the comparability of data within the network and improving it.

Countries that have discontinued reporting to GEMS/AIR are being addressed with a view to revitalizing their participation.

169. Awareness of the impact of enhanced incidence of UV-B due to ozone layer depletion and the effects of global warming on the generation of atmospheric pollution needs to be taken into account in the planning of long-term actions to reduce air pollution and its transboundary transport.

Notes

1/ Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992, vol. I, Resolutions Adopted by the Conference (United Nations publications, Sales No. E.93.I.8 and corrigendum), resolution 1, annex II.

2/ Addendum to the report of the Conference of the Parties to the United Nations Framework Convention on Climate Change on its first session, Berlin, 28 March-7 April 1995 (FCCC/CP/1995/7/Add.1), chap. I, decision 1/CP.1.

3/ Official Records of the Economic and Social Council, 1995, Supplement No. 12 (E/1995/32), chap. I, sect. D.5.